

REMARKS

I. The Drawings Comply with 37 CFR 1.83(a).

In the Office Action, the Examiner objected to the drawings under 37 CFR 1.83(a), reasoning that the drawings do not show all of the features in claims 8, 9, 19, and 20. Following a telephone conversation between the Examiner and Applicant's counsel on July 8, 2005, the Examiner represented that Rule 83(a) is satisfied if one member of a Markush group is illustrated in the drawings. In this case, the drawings depict the circular embodiment referenced in the claims. Thus, the Examiner represented that the drawing requirement has been withdrawn.

II. The Claims as Amended Comply with 35 USC § 112.

The Examiner rejected claims 9, 10, 19, and 20 under 35 USC § 112, second paragraph, on the grounds that the phrase "or other shape" renders the claims indefinite. To overcome this rejection, the Examiner suggested deleting the phrase "polygonal or other shape" in each of these claims and substituting therefore the phrase "or polygonal." As an initial consideration, claim 8, rather than claim 10, includes the phrase "or other shape." Consequently, Applicant has adopted the Examiner's suggested language in amending claims 8, 9, 19 and 20. The claims as amended comply with 35 USC § 112 and the rejection should be withdrawn.

III. The Claims are not Obvious over the Prior Art Relied Upon by the Examiner.

Claims 1-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Loftus (U.S. Pat. No. 6,007,325) in view of Benson (U.S. Pat. No. 6,672,858). Independent claim 1 provides for a compact gas burner apparatus having a short flame length and a high turndown ratio for discharging a mixture of fuel gas and air into a furnace space wherein the mixture is burned and flue gases having low NO_x content are formed therefrom. This novel compact gas burner comprises:

a housing having an open end attached to the furnace space;

means for introducing a controlled flow rate of the air into the housing attached thereto;

a burner tile attached to the open end of the housing having an opening formed therein for allowing the air to flow therethrough and having a wall surrounding the opening which extends

into the furnace space, the exterior sides of the wall being divided into sections by a plurality of radially positioned baffles attached thereto with alternate sections having different heights and slanting towards the opening at different angles and one or more of the alternating sections having a primary fuel gas passageway formed therein for conducting primary fuel gas from outside the section to within the wall; and

a plurality of fuel gas nozzles connected to the source of fuel gas positioned outside the wall of the burner tile for discharging secondary fuel gas adjacent to the external slanted wall sections with one or more of the fuel gas nozzles also discharging primary fuel gas mixed with flue gases into and through the primary fuel gas passageways whereby the secondary fuel gas mixes with flue gases in the furnace space, the mixture of secondary fuel gas and flue gases mixes with unburned air, primary fuel gas and flue gases flowing through the opening and wall of the burner tile, and the resultant mixture is burned in the furnace space.

Independent claim 14 provides for a compact gas burner apparatus having a folded flame pattern, a short flame length and a high turndown ratio for discharging a mixture of fuel gas and air into a furnace space wherein the mixture is burned and flue gases having low NO_x content are formed therefrom. The apparatus of claim 14 comprises:

a housing having an open end attached to the furnace space;

an air register for introducing a controlled flow rate of air into the housing attached thereto;

a burner tile attached to the open end of the housing having an opening formed therein for allowing the air to flow therethrough and having a wall surrounding the opening which extends into the furnace space, the exterior sides of the wall being divided into sections by a plurality of radially positioned baffles attached thereto with alternate sections having the same or different heights and slanting towards the opening at the same or different angles, a first of the alternating wall sections having a short height and slanting towards the opening at a large angle, the second of the wall sections having the same or a taller height and slanting towards the opening at the same or a smaller angle and successive alternating sections having heights and angles which are

the same as the first and second sections, every other of the slanted wall sections also having a passageway formed therein for conducting primary fuel gas and flue gases into the interior of the wall; and

a plurality of fuel gas nozzles connected to the source of fuel gas and positioned outside the wall of the burner tile for discharging secondary fuel gas adjacent to the external slanted wall sections whereby the secondary fuel gas mixes with flue gases in the furnace space and the resultant mixture mixes with unburned air, primary fuel gas and flue gases flowing through the opening and wall in the burner tile, and is burned in the furnace space, and a portion of the fuel gas nozzles discharging primary fuel gas mixed with flue gases through every other passageway in the slanted wall sections into the interior of the burner tile wherein the primary fuel gas and flue gases mix with air therein.

The Examiner found that “Loftus et al does not disclose the gas nozzles outside the tile with some discharging through primary gas passageways.” (Office Action, Page 4.) The Examiner combined Loftus with Benson, reasoning that the secondary reference teaches “a plurality of fuel gas nozzles 22 and 23 positioned outside the burner tile 13.”

However, a prima facie case of obviousness has not been established. In order to establish a prima facie case of obviousness by combining multiple prior art references, “[t]he Examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.” In re Rouffet, 149 F.3d 1350, 1357, 47 U.S.P.Q.2d 1453 (Fed. Cir. 1998). The prior art must contain some suggestion or incentive that would have motivated an artisan to modify the reference. See In re Fine, 837 F.2d 1071, 1074, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). In addition, the prior art must suggest the desirability and obviousness of making the modification without the slightest recourse to the teachings in the application. See Amgen, Inc. v. Chugai Pharmaceutical Co., Ltd., 927 F.2d 1200, 18 U.S.P.Q.2d 1016 (Fed. Cir. 1991). These requirements have not been met.

A. There is no incentive to combine the prior art references.

Significantly, there is no incentive to combine the prior art references in the manner set forth by the Examiner. In relying on the combination of the above references, the Examiner improperly used “the claimed invention itself as a blueprint for piecing together elements in the prior art to defeat the patentability of the claimed invention.” In re Rouffet, 149 F.3d 1350, 1357, 47 U.S.P.Q.2d 1453 (Fed. Cir. 1998). It is well established that the prior art references themselves must suggest the desirability and obviousness of making the modification without the slightest recourse to the teachings in the application. See Amgen, Inc. v. Chugai Pharmaceutical Co., Ltd., 927 F.2d 1200, 18 U.S.P.Q.2d 1016 (Fed. Cir. 1991). As a result, the Examiner has used impermissible hindsight to combine components from the prior art and has failed to sufficiently show reasons that a skilled artisan would combine the cited references to arrive at the claimed invention.

B. The combination of references does not suggest all of the limitations of the claimed invention.

Even if such a combination were supportable, the combination of references relied upon by the Examiner still would not yield the claimed invention. The prior art reference or combination of references must teach or suggest all of the limitations of the claims. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). See also In re Wilson, 424 F.2d 1382, 1385, 165 U.S.P.Q.494, 496 (CCPA 1970). The Examiner apparently concedes that neither of the references teaches a burner tile having alternate sections with different heights and slanting toward the opening into the furnace space at different angles. Nevertheless, he concludes that “it would have been an obvious matter of design choice to a person of ordinary skill in the art to have a burner tile with alternating walls having different heights, having different sloping angle to the burner tile opening . . .” Without providing any basis for his conclusion, the Examiner reasons that “Applicant has not disclosed that alternating walls having different heights, having different sloping angle to the burner tile opening . . . provides an advantage, is used for a particular purpose, or solves a stated problem.” (Office Action, page 5.)

Of course, the PTO has the burden of establishing a prima facie case of obviousness, and “the question under 35 USC 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983). Here, the specification and claims both disclose that the instant burner apparatus has a shorter flame, a higher turndown ratio and more compact dimensions than prior art burners utilizing the techniques such as those taught in Loftus and Benson. See, e.g. Application at page 2, lines 10-11 and claims 1 and 14.

Nothing in either of the prior art references, alone or in combination, suggests that the prior art should be modified to include a burner tile with an exterior wall in which alternate sections have different heights and slant toward the interior at different angles. Furthermore, the instant burner includes at least two other limitations not suggested by the combination of prior art references relied upon by the Examiner. First, the claimed burner includes radially positioned baffles attached to the exterior side of the burner wall. The references relied upon by the Examiner do not teach or suggest that the prior art burners should be modified to include radially positioned baffles. Unlike the slots in Loftus or the indentions in Benson, these baffles help to create a folded flame shape and connect the primary flames and the secondary flames as a continuous folded or flower shaped flame. The instant burner uniformly mixes the flue gas with the combustion flames. As a result, the claimed apparatus offers a high turndown ratio and improved flame stability.

Second, the burner of claims 14-23 additionally provides that every other of the slanted wall sections has a passageway for conducting primary fuel gas and flue gases into the interior of the burner wall. In fact, Benson actually teaches away from using a burner configuration in which only alternating sections comprise such passageways. “Teaching away is the per se demonstration of lack of prima facie obviousness.” In re Dow Chemical Co., 837 F.2d 469, 5 U.S.P.Q.2d 1529 (Fed. Cir. 1988). The inclusion of alternating passageways would be contrary to the function and underlying purpose of the Benson method. Benson is premised on entraining “dramatically increased” amounts of furnace gases into the interior of the burner, requiring an

increase in the number and/or physical size of the recirculation ports. (Col. 2, lines 45-64 and Col. 5, lines 24-28, Col. 6, lines 9-14.) Rather than decreasing the number of ports such that only alternating sections comprise ports, Benson actually increases the number of ports by 1.5 to 2.0 times. (Col. 2, lines 64-66.) Because the combination of prior art references does not disclose all of the limitations of the claimed invention, a prima facie case of obviousness has not been established.

C. The claimed invention has novel features performing a novel technique to overcome the problems of the prior art.

Generally, NOx emissions are lowered by reducing combustion temperature. One method of reducing combustion temperature is to avoid stoichiometric conditions by supplying either less or excess air to create fuel rich or fuel lean conditions. Many prior art techniques achieve this goal by injecting a secondary fuel downstream of the primary flame, resulting (as in Loftus) in a longer flame. Retrofitting traditional furnaces with such burners can create problems because longer flames often impinge the top furnace tubes. Another prior art method of reducing combustion temperature is to entrain relatively large amounts of flue gas into the combustion zone. The disadvantage of entraining more flue gas is a decreased turndown ratio. Too much flue gas entrainment can extinguish the flame. Some prior art methods, as in Benson, utilize a combination of these techniques. However, this technique requires large burner dimensions. For example, the improvement of the Benson technique is “the ability to recirculate a large amount of furnace gases back to the burner for mixing with the fuel gas prior to combustion.” (Col. 2, lines 22-26 and Col. 5, lines 22-29.) According to Benson, this objective is achieved by increasing the available cross-sectional area of the recirculation ports located around the circumference of the burner tile. (Col. 2, lines 45-52.) The Benson method increases the total number of ports and/or the physical size of each port. (Col. 2, lines 63-66.) In order to adequately mix the large amount of furnace gases with the fuel, the tile wall thickness is greatly increased over prior art burners. (Col. 5, lines 60-66 and Col. 6, lines 1-3.)

The instant burner utilizes a novel technique to overcome the problems of long flame length, low turndown ratio and large burner dimensions. The instant apparatus directs the flame in a radial, rather than longitudinal, direction and forms a deeply folded flame with an increased flame surface. The larger flame surface reduces the combustion heat intensity and lowers the flame temperature. In addition, the claimed invention does not rely upon entraining a dramatically increased amount of furnace gases into the primary combustion zone. Instead, the novel burner arrangement uniformly mixes flue gas with a large folded flame surface to lower NOx emissions. As a result, the instant burner has more compact dimensions, a shorter flame and a higher turndown ratio.

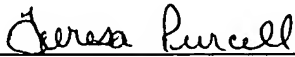
In sum, the PTO has not met its burden of establishing a prima facie case that independent claims 1 and 14 are obvious over the prior art. Further, dependent claims are non-obvious under 35 U.S.C. § 103 if claims from which they depend are non-obvious. See In re Fine, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). Thus, claims 1-13 and 15-23 are non-obvious, because they all depend from non-obvious claims. Moreover, the dependent claims each call for one or more additional limitations that distinguish the present invention from the prior art. Therefore, a prima facie case of obviousness has not been established with regard to claims 1-23.

CONCLUSION

For the foregoing reasons, the rejections under § 112 and § 103 should be withdrawn. The references relied upon by the Examiner do not teach, suggest or imply that the prior art should be modified to comprise the invention set forth in claims 1-23. Accordingly, Applicant respectfully submits that claims 1-23 are in condition for allowance and such action is respectfully requested.

This is intended to be a complete response to the Office Action mailed on May 5, 2005.

I hereby certify that this correspondence is being deposited in the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.



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